

FIG. 1

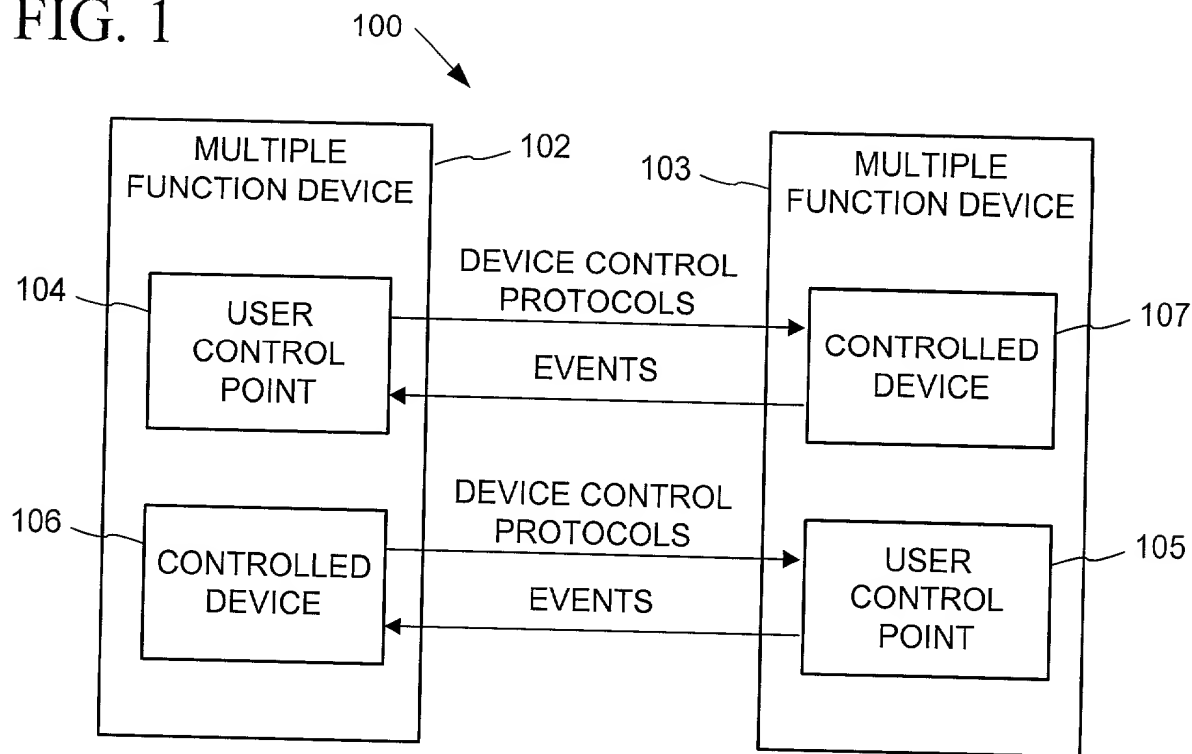


FIG. 2

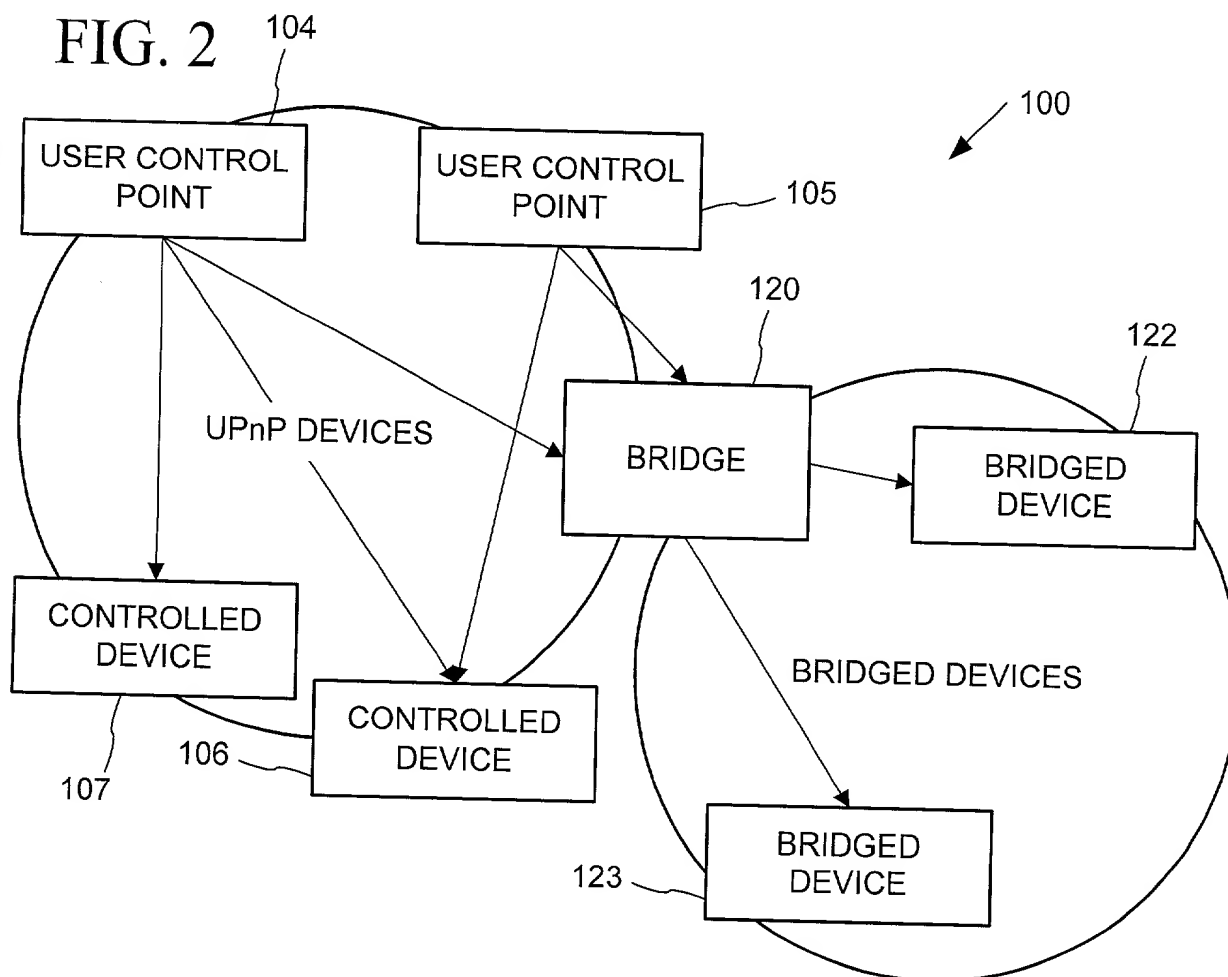


FIG. 3

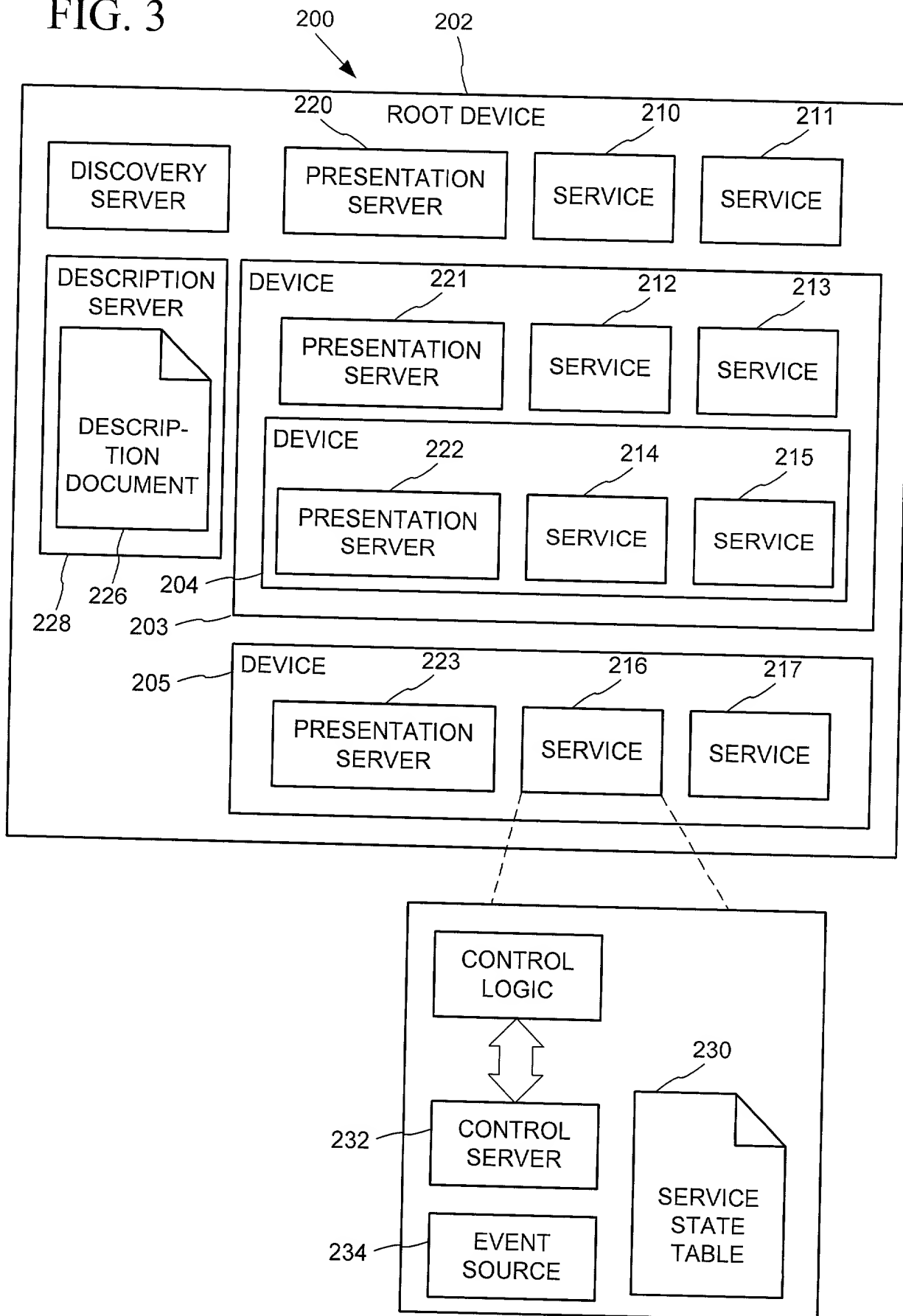


FIG. 4

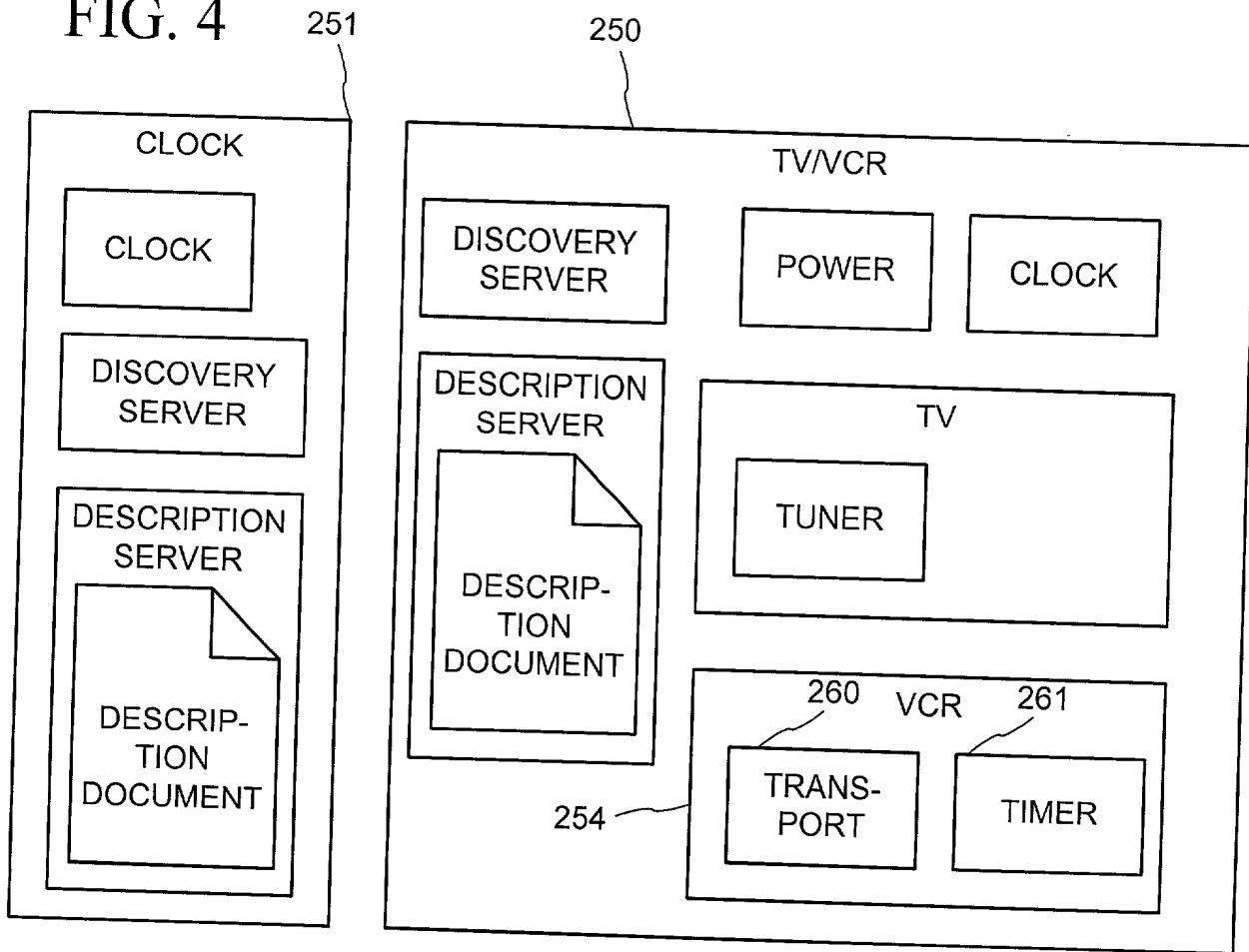


FIG. 5

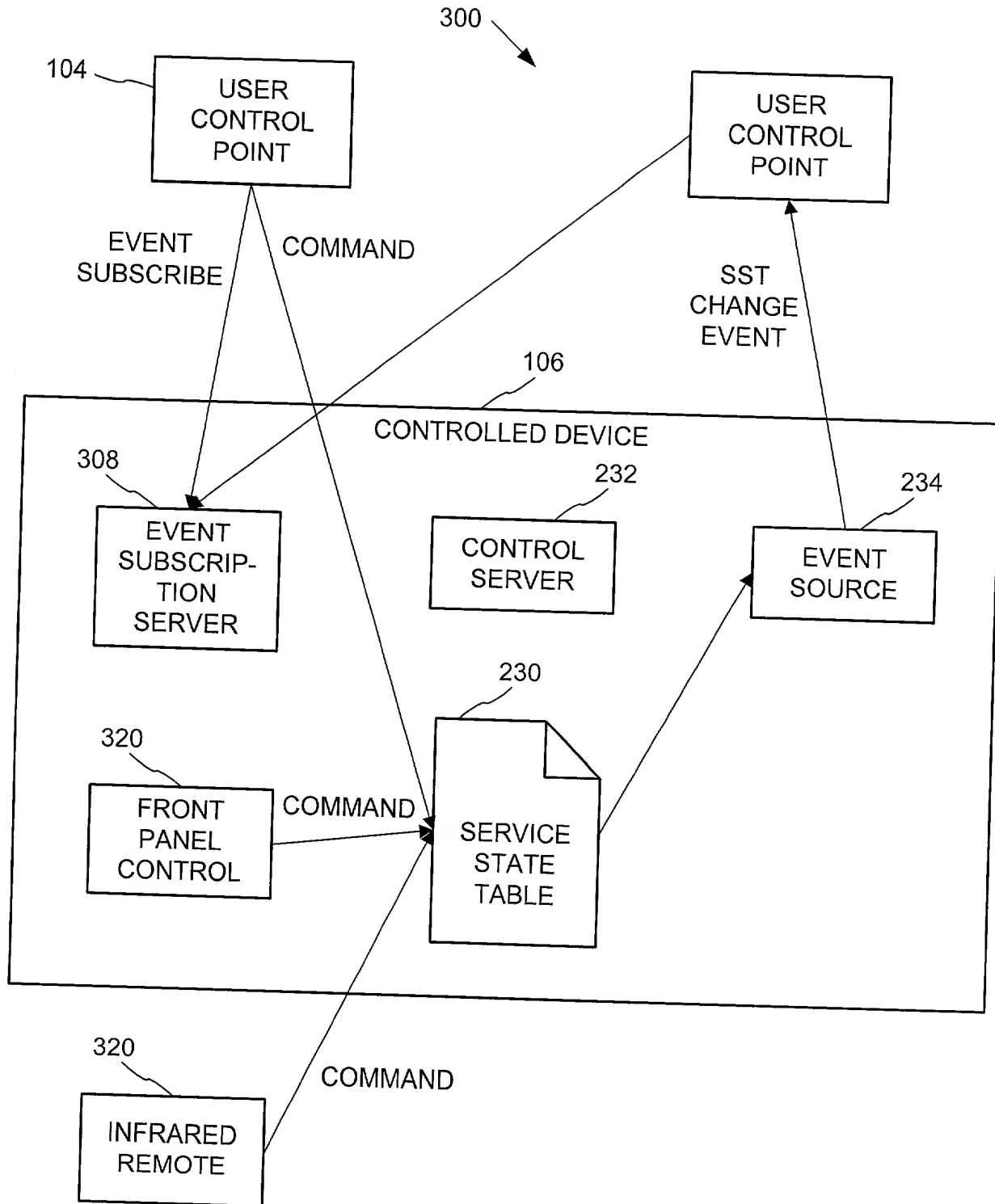


FIG. 6

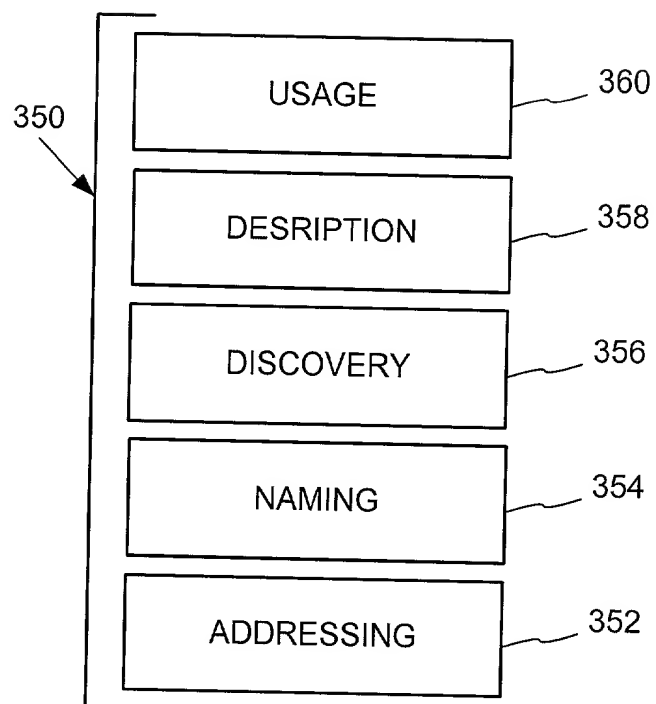


FIG. 7

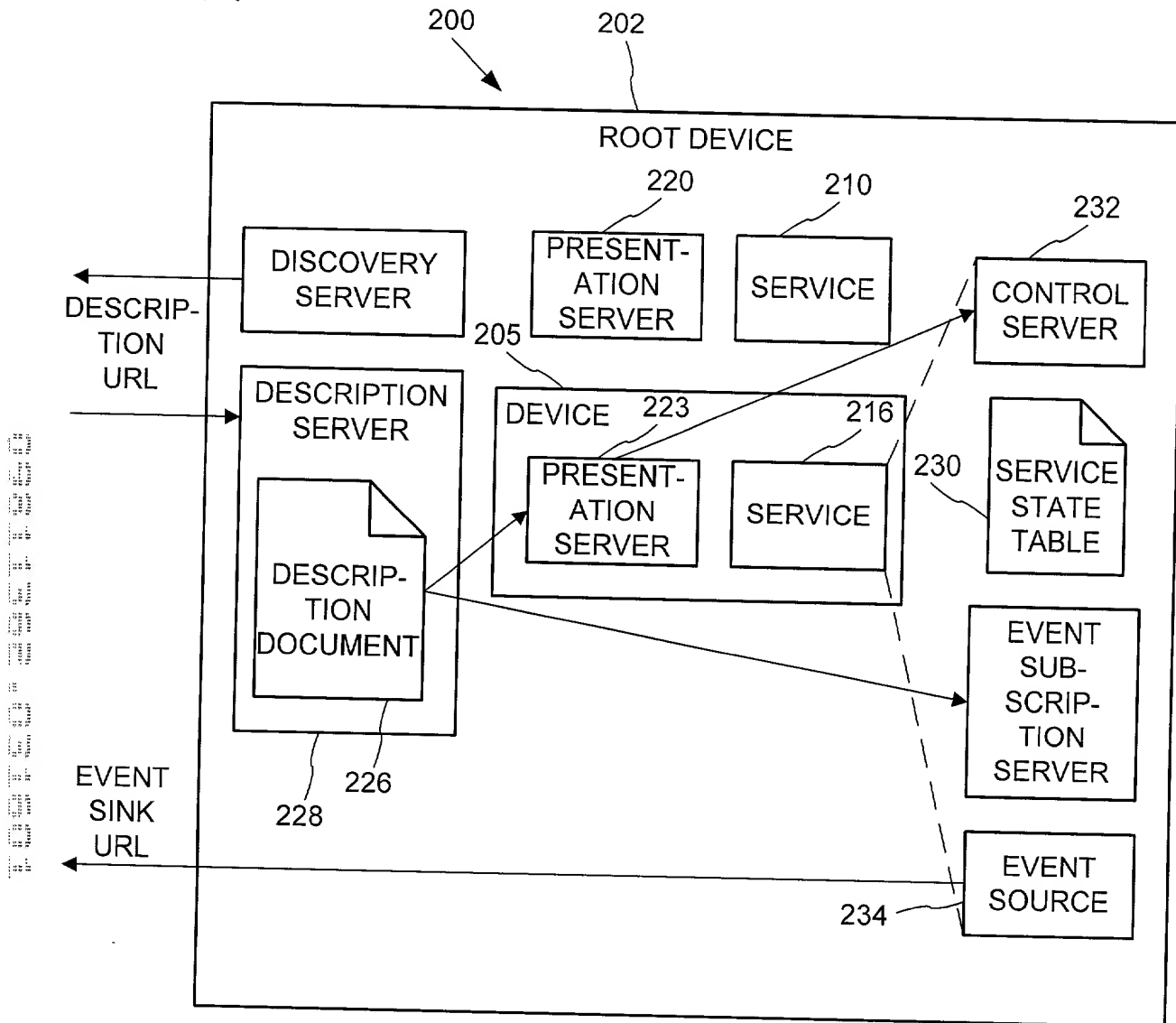


FIG. 8

400

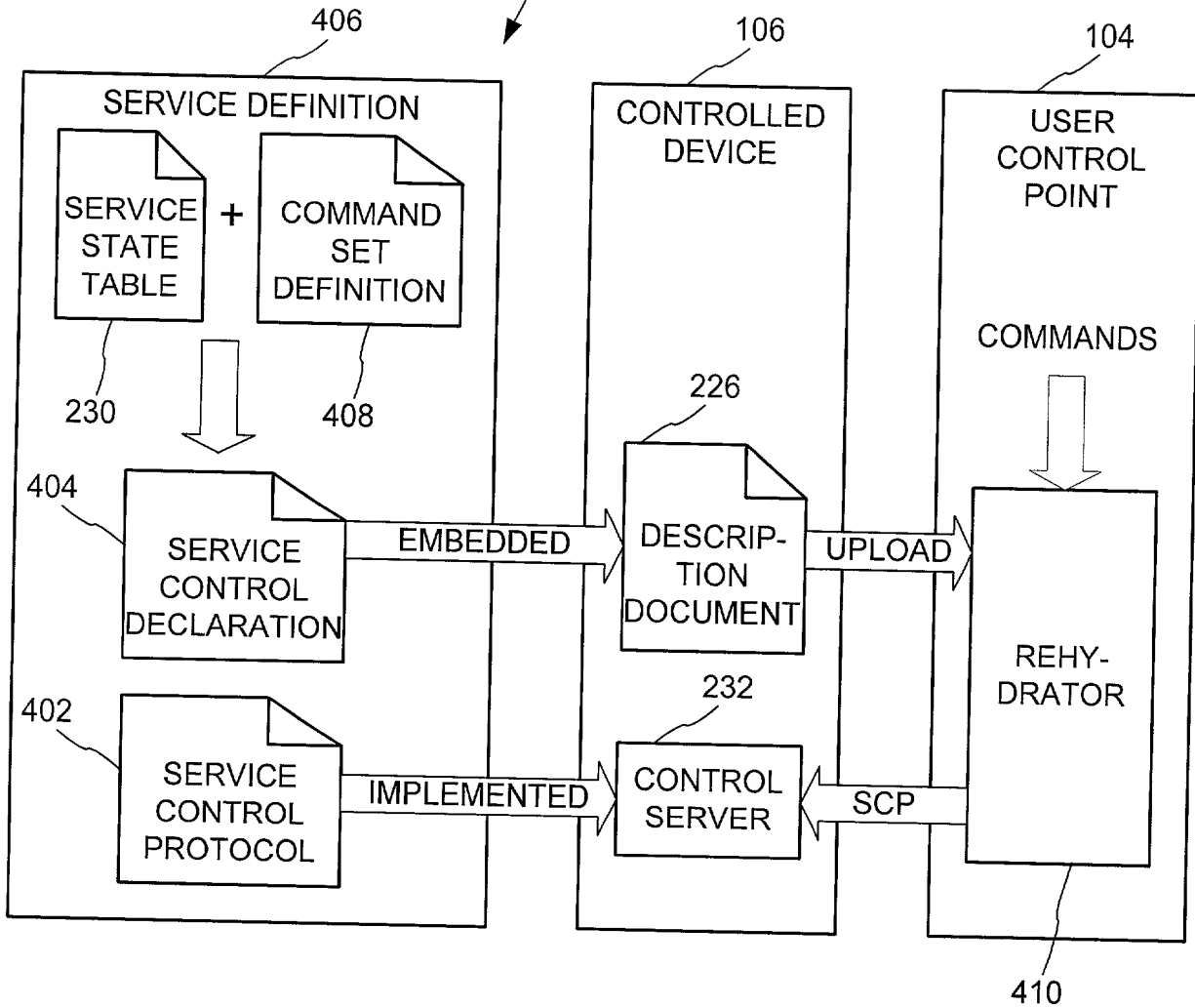


FIG. 9

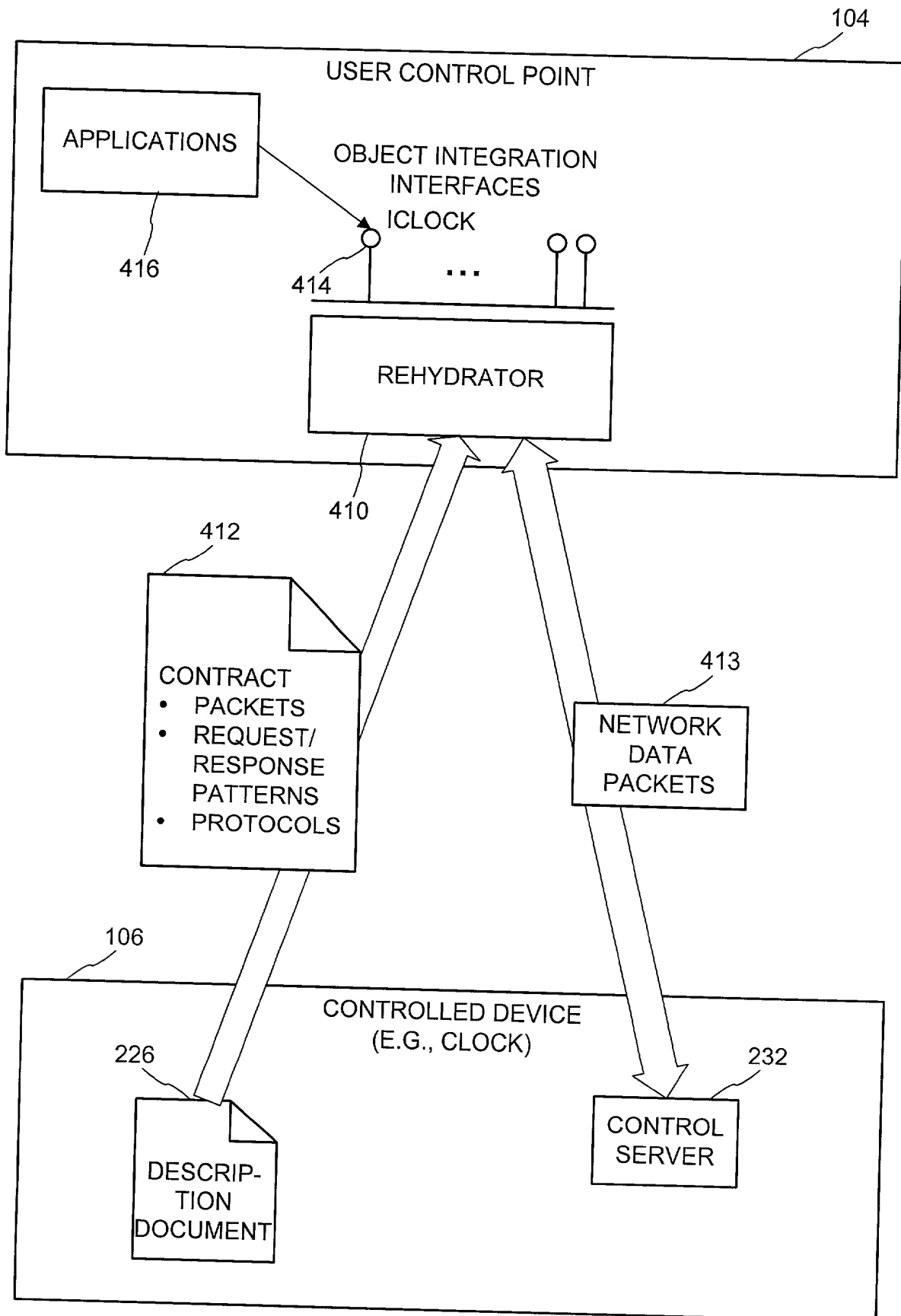


FIG. 10

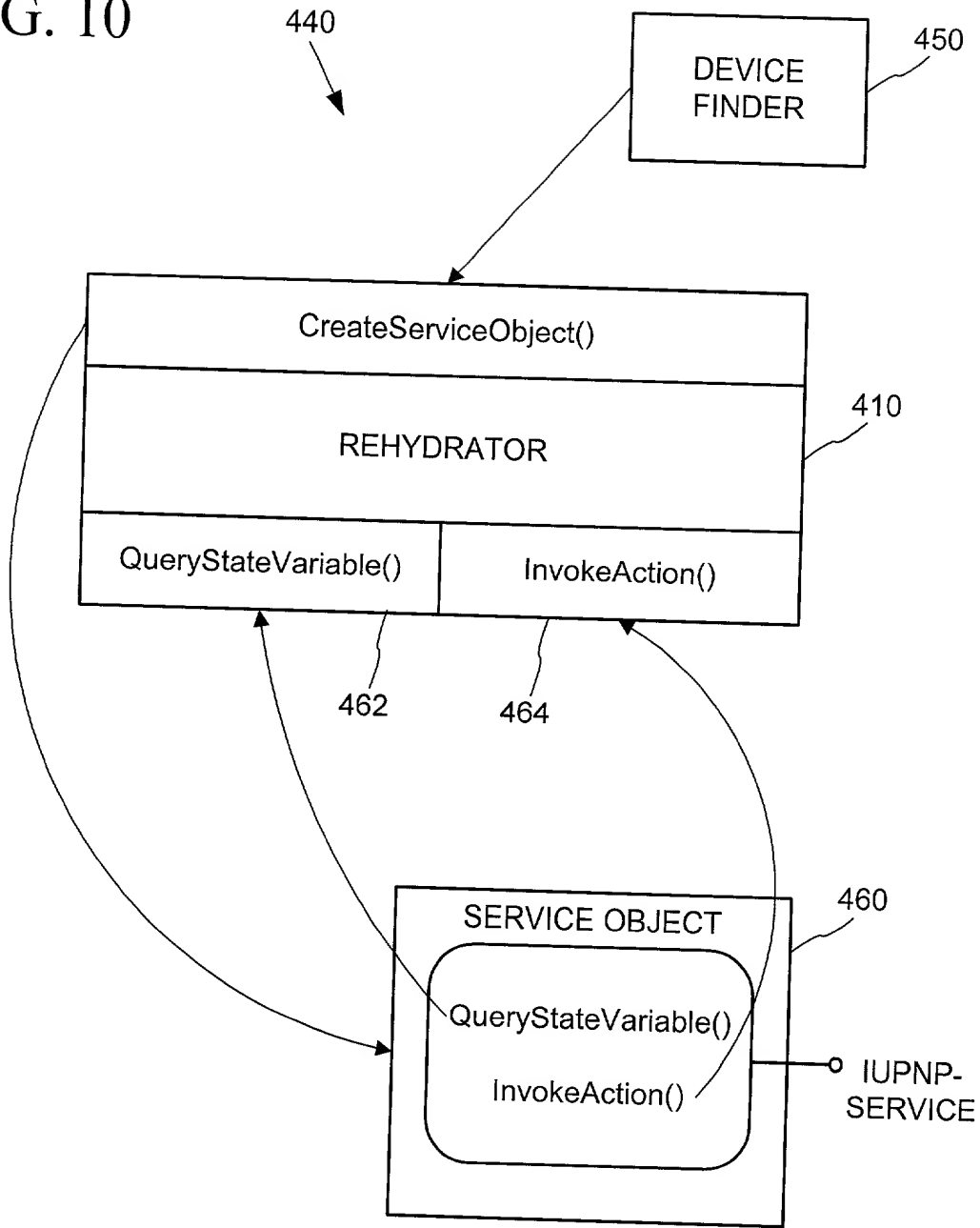
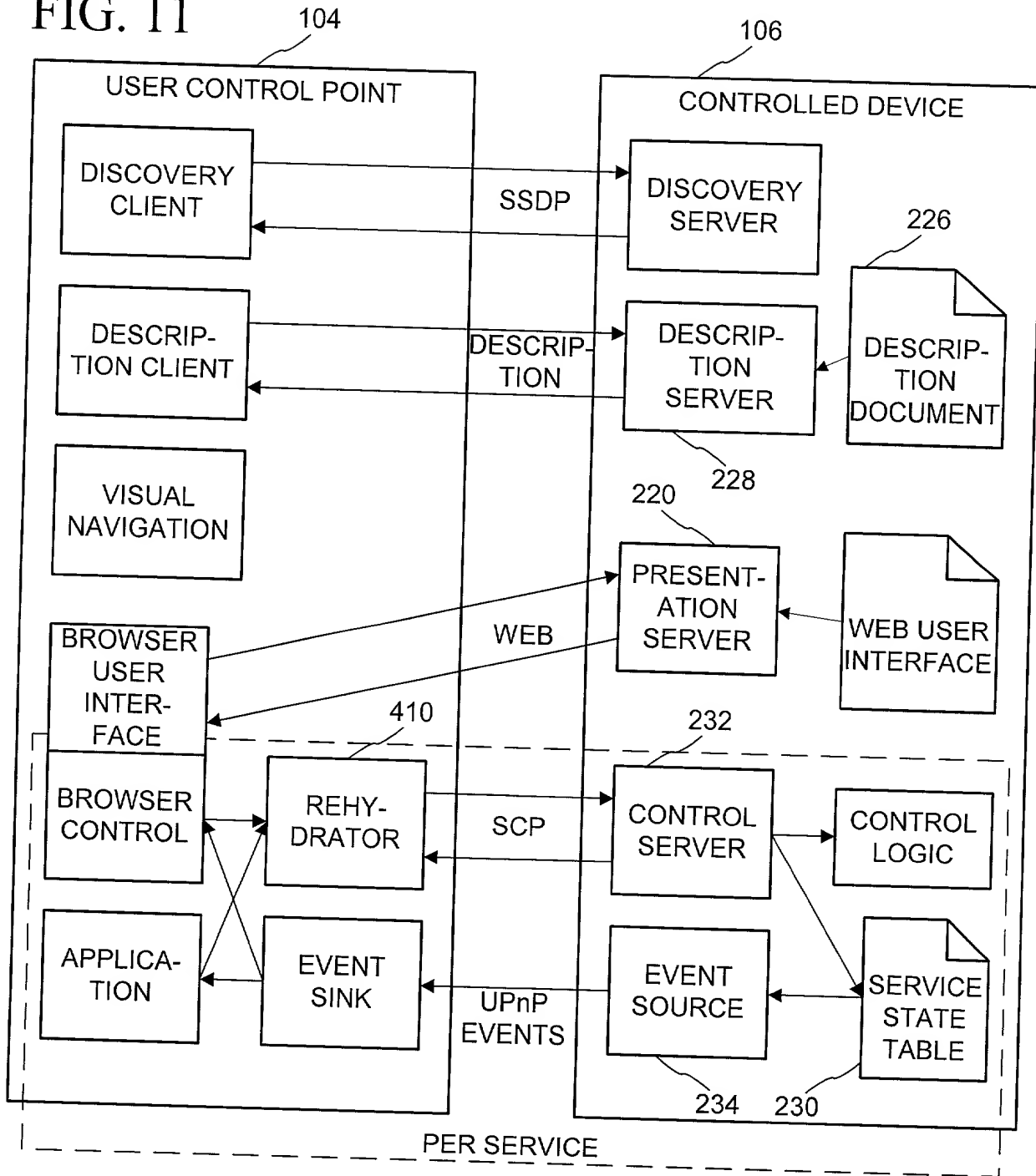


FIG. 11



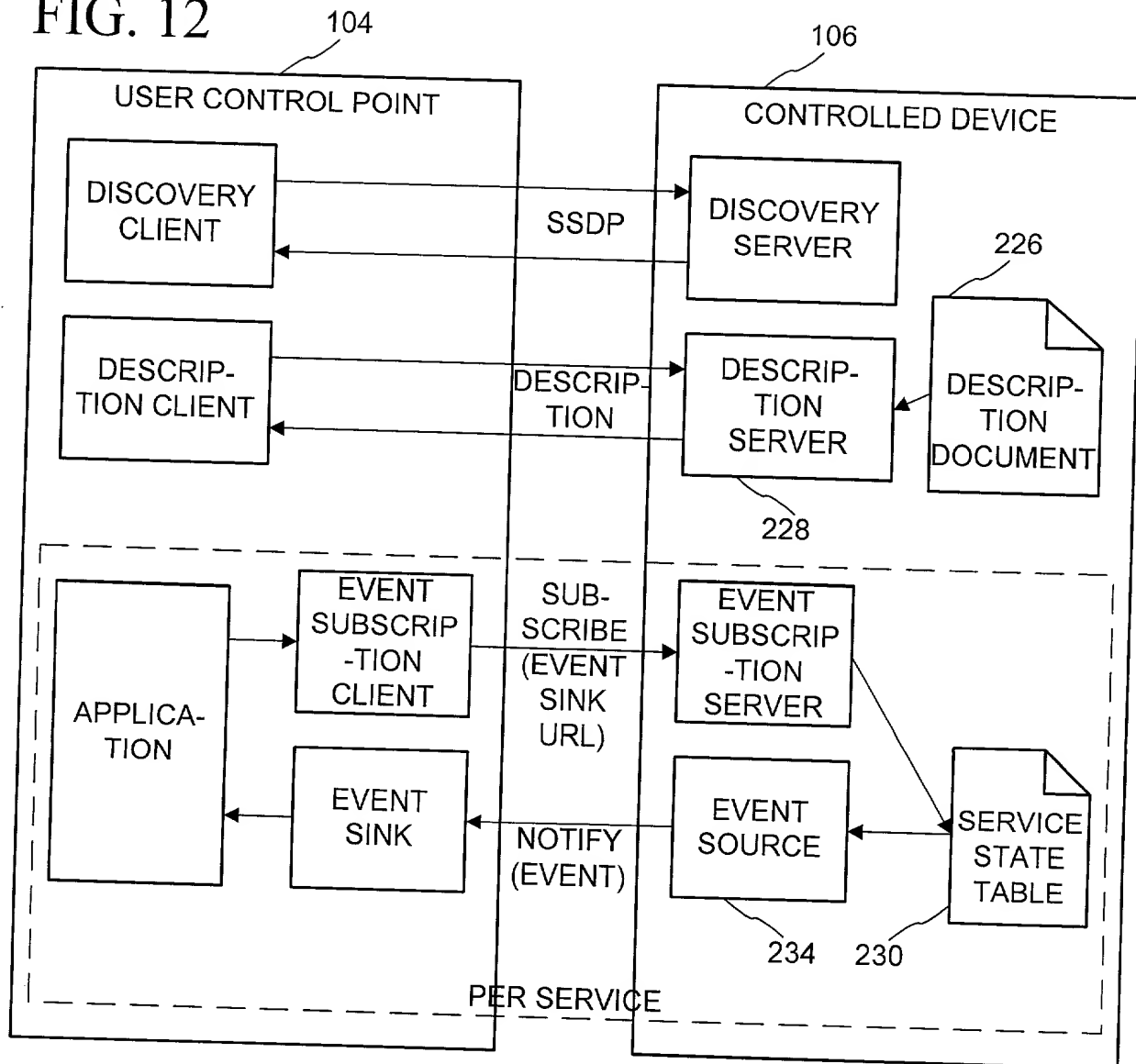
[illegible]

FIG. 13

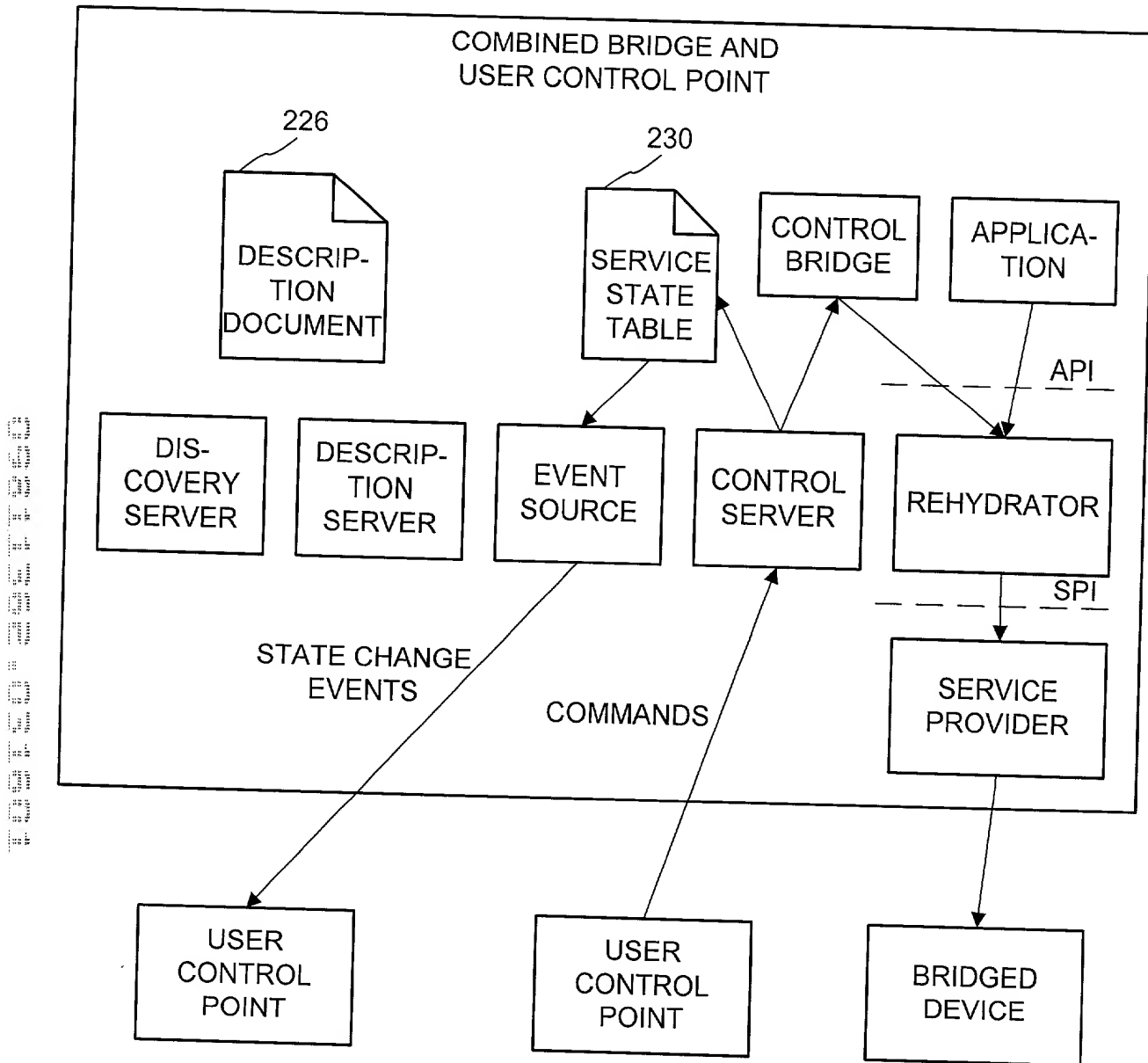


FIG. 14

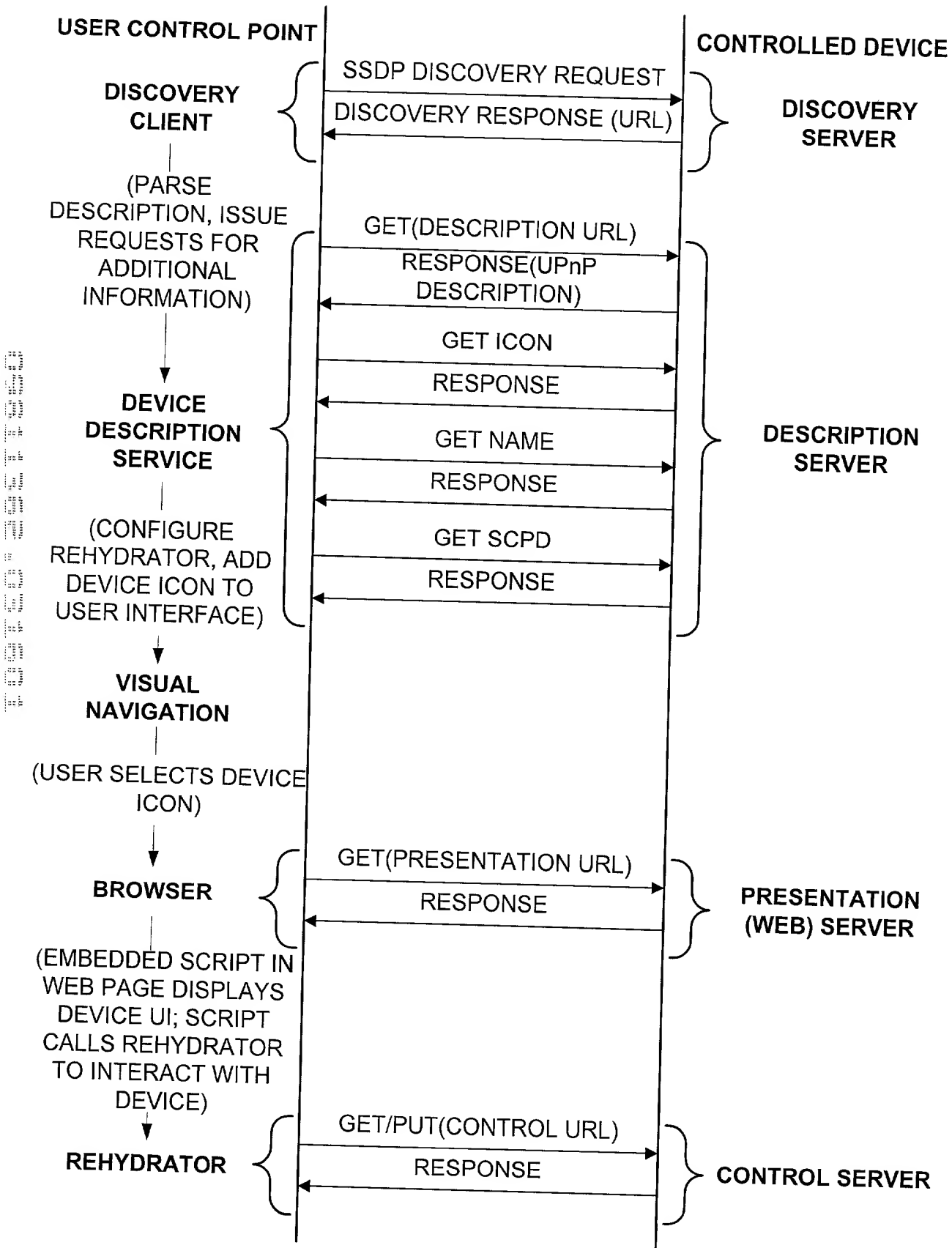


FIG. 15

root

- specVersionMajor
- specVersionMinor
- URLBase
- manufacturer
- manufacturerURL
- modelName
- modelNumber
- modelDescription
- modelURL
- UPC
- serialNumber
- device
 - UDN
 - friendlyName
- deviceType
- presentationURL
- iconList
 - icon
 - size
 - color
 - depth
 - imageType
 - imageURL
 - icon
 - icon
- service
 - serviceType
 - controlURL
 - eventSubURL
 - SCPD
- service
- service
- device
 - service
 - service
 - device
 - service
- device
- device

FIG. 16

```
<device>
...
<iconList>
  <icon>
    <size>16</size>
    <color>0</color>
    <depth>8</depth>
    <imageType>PNG</imageType>
    <image>"http://device.local/iconpath/icon16bw.png"</image>
  </icon>
  <icon>
    <size>32</size>
    <color>0</color>
    <depth>8</depth>
    <imageType>PNG</imageType>
    <image>"http://device.local/iconpath/icon32bw.png"</image>
  </icon>
  <icon>
    <size>48</size>
    <color>0</color>
    <depth>8</depth>
    <imageType>PNG</imageType>
    <image>"http://device.local/iconpath/icon48bw.png"</image>
  </icon>
  <icon>
    <size>16</size>
    <color>1</color>
    <depth>8</depth>
    <imageType>PNG</imageType>
    <image>"http://device.local/iconpath/icon16c.png"</image>
  </icon></device>
  <icon>
    <size>32</size>
    <color>0</color>
    <depth>8</depth>
    <imageType>PNG</imageType>
    <image>"http://device.local/iconpath/icon32c.png"</image>
  </icon>
  <icon>
    <size>48</size>
    <color>0</color>
    <depth>8</depth>
    <imageType>PNG</imageType>
    <image>"http://device.local/iconpath/icon48c.png"</image>
  </icon>
  ...
</iconList>
...
</device>
```

FIG. 17

```
<?xml version="1.0"?>
<scpd xmlns="x-schema:scpdl-schema.xml">
  <service StateTable>
    <stateVariable>
      <name>currentChannel</name>
      <dataType>number</dataType>
      <allowedValueRange>
        <minimum>0</minimum>
        <maximum>55</maximum>
        <step>1</step>
      </allowedValueRange>
    </stateVariable>
  </serviceStateTable>

  <actionList>
    <action>
      <name>ChannelUp</name>
    </action>

    <action>
      <name>ChannelDown</name>
    </action>

    <action>
      <name>SetChannel</name>
      <argument>
        <name>newChannel</name>
      <relatedStateVariable>
        currentChannel
      </relatedStateVariable>
    </argument>
  </action>
</actionList>
</scpd>
```


FIG. 18

```

<contract>
  <protocol id="protocolDef">
    <HTTP version="1.1">
      <URL></URL>
      <M-POST>
        <MAN>http://www.microsoft.com/protocols/ext/XOAP</MAN>
      </M-POST>
      <HEADER name="Content-Type" value="text/xml" />
      <!-- Need to put in extension headers here -->
    </HTTP>

  </protocol>

  <RequestResponse name="queryStateVariable">
    <protocol is="protocolDef">
      <in is="queryStateVariable">
        <out is="queryStateVariableResponse">
          <error is="queryStateVariableResponse">
        </RequestResponse>

  <RequestResponse name="invokeAction">
    <protocol is="protocolDef">
      <in is="SerializedStream">
        <out is="invokeActionResponse">
          <error is="invokeActionResponse">
        </RequestResponse>

  <Schema name="upnp_scpdl"
    xmlns="urn:schemas-microsoft-com:xml-data"
    xmlns:dt="urn:schemas-microsoft-com:datatypes">

    <!-- Common -->

    <ElementType name="_return" content="textOnly" dt:type="string" />
    <ElementType name="_fault" content="textOnly" dt:type="string" />

    <!-- Query State Variable Call -->

    <ElementType name="variableName" content="textOnly" dt:type="string" />

    <ElementType name="queryStateVariable" content="eltOnly" model="closed">
      <element type="variableName" />
    </ElementType>

    <!-- Query State Variable Response -->

```

FIG. 19

```
...
<ElementType name="queryStateVariableResponse" content="eltOnly"
model="closed">
  <group order="one">
    <element type="_return">
      <element type="_fault">
    </group>
  </ElementType>

<!-- Invoke Action Call -->

<AttributeType name="main" dt:type="idref" />
<AttributeType name="headers" dt:type="idref" />
<AttributeType name="id" dt:type="id" />

<ElementType name="sequenceNumber" content="textOnly" dt:type="int">
  <AttributeType name="dt" dt:type="string" dt:values="int" />

  <attribute type="dt" />
</ElementType>

<ElementType name="headers" content="eltOnly" model="closed"
  <attribute type="id" required="yes" />
  <element type="sequenceNumber" />
</ElementType>

<ElementType name="actionName" content="textOnly" dt:type="string" />
<ElementType name="actionArg" content="textOnly" dt:type="string" />

<ElementType name="invokeAction" content="eltOnly" model="closed">
  <attribute type="id" required="yes" />

  <element type="actionName">
    <element type="actionArg" minOccurs="0" maxOccurs="*">
  </ElementType>

```

...

FIG. 20

```
...
<ElementType name="SerializedStream" content="eltOnly" model="closed">
  <attribute type="main" required="yes" />
  <attribute type="headers" required="yes" />

  <element type="headers">
  <element type="invokeAction">

</ElementType>

<!-- Invoke Action Response -->

<ElementType name="invokeActionResponse" content="eltOnly" model="closed">
  <group order="one">
    <element type="_return">
    <element type="_fault">
  </group>
</ElementType>
</Schema>
</contract>
```

FIG. 21

```
<?xml version="1.0"?>
<Schema name="upnp_scpdl"
  xmlns="urn:schemas-microsoft-com:xml-data"
  xmlns:dt="urn:schemas-microsoft-com:datatypes">

  <!-- Common Elements and Attributes -->

  <ElementType name="name" content="textOnly" dt:type="string" />

  <!-- Service State Table -->

  <ElementType name="minimum" content="textOnly" dt:type="number" />
  <ElementType name="maximum" content="textOnly" dt:type="number" />
  <ElementType name="step" content="textOnly" dt:type="number" />

  <ElementType name="allowedValueRange" content="eltOnly" model="closed">
    <element type="minimum" />
    <element type="maximum" />
    <element type="step" minOccurs="0" />
  </ElementType>

  <ElementType name="allowedValue" content="textOnly" />

  <ElementType name="allowedValueList" content="eltOnly" model="closed">
    <element type="allowedValue" minOccurs="1" maxOccurs="*" />
  </ElementType>

  <ElementType name="dataType" content="textOnly" dt:type="string" />

  <ElementType name="stateVariable" content="eltOnly" model="closed">
    <element type="name" />
  </ElementType>

  ...
</Schema>
```

FIG. 22

```

...
    <element type="dataType" />

    <group minOccurs="0" maxOccurs="1" order="one">
        <element type="allowedValueRange" />
        <element type="allowedValueList" />
    </group>
</ElementType>

<ElementType name="deviceStateTable" content="eltOnly" model="closed">
    <element type="stateVariable" minOccurs="1" maxOccurs="*" />
</ElementType>

<!-- Action List -->

<ElementType name="relatedStateVariable" content="textOnly" dt:type="string" />

<ElementType name="argument" content="eltOnly" model="closed">
    <element type="name" />
    <element type="relatedStateVariable" />
</ElementType>

<ElementType name="action" content="eltOnly" model="closed">
    <element type="name" />
    <element type="argument" minOccurs="0" maxOccurs="*" />
</ElementType>

<ElementType name="actionList" content="eltOnly" model="closed">
    <element type="action" minOccurs="0" maxOccurs="*" />
</ElementType>

<!-- Root Element -->

<ElementType name="dcpd" content="eltOnly" model="closed">
    <element type="deviceStateTable" />
    <element type="actionList" />
</ElementType>
</Schema>

```

FIG. 23

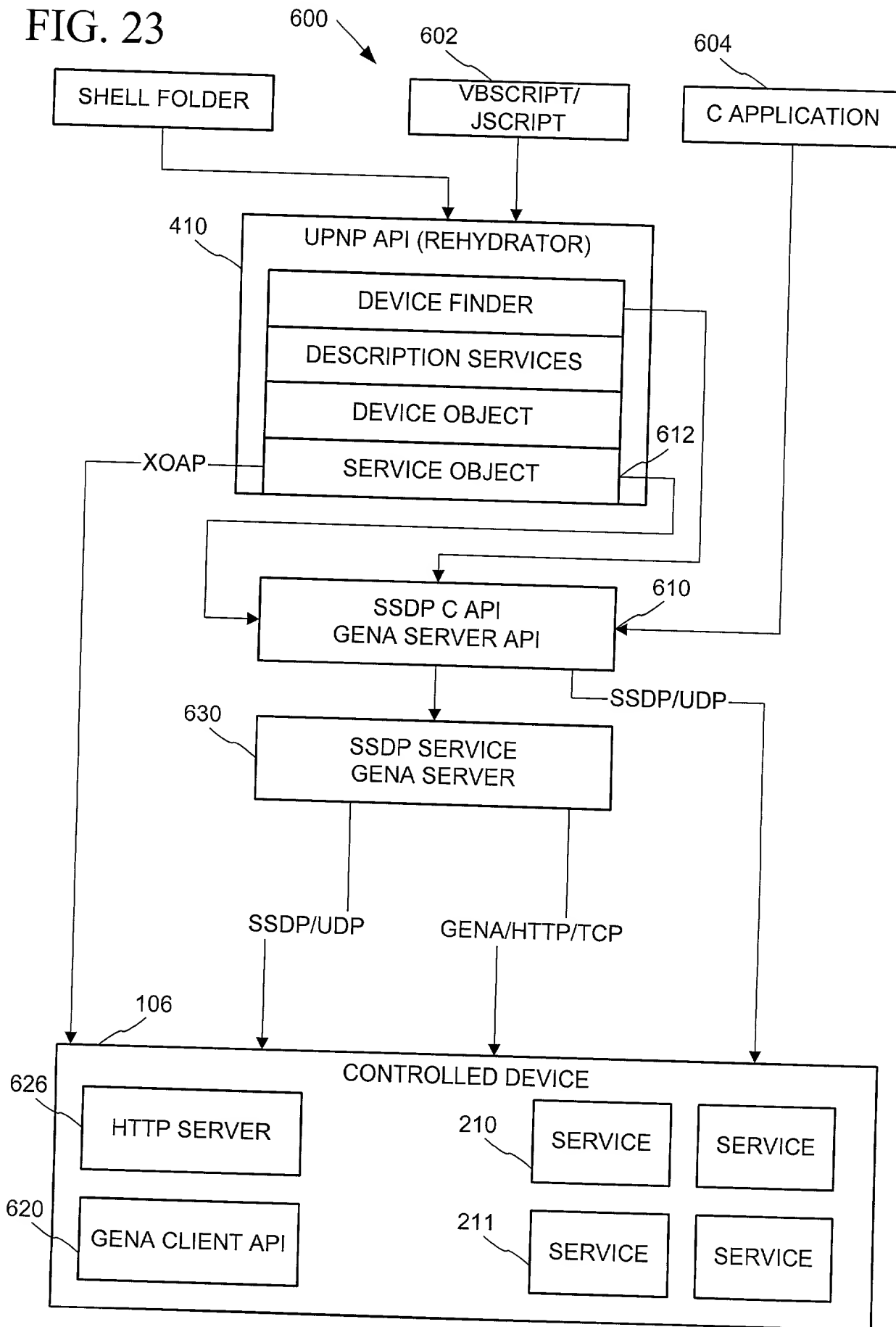


FIG. 24

USER CONTROL POINT

CONTROLLED DEVICE

RegisterNotification()

SUBSCRIBE (Callback + Timeout)

RegisterEventSource()

RESPONSE: SID + TIMEOUT

NOTIFY (SID)

SubmitUpnpProperty-
Event()

200 OK

NOTIFY (SID)

SubmitUpnpProperty-
Event()

200 OK

UNSUBSCRIBE (SID)

DeRegisterNotification()

200 OK

FIG. 24 is a sequence diagram illustrating the interaction between a User Control Point and a Controlled Device for event subscription and notification. The diagram shows the following sequence of messages: 1. The User Control Point sends a SUBSCRIBE (Callback + Timeout) message to the Controlled Device. 2. The Controlled Device sends a RESPONSE: SID + TIMEOUT message back to the User Control Point. 3. The User Control Point sends a NOTIFY (SID) message to the Controlled Device. 4. The Controlled Device sends a SubmitUpnpProperty-Event() message back to the User Control Point. 5. The User Control Point sends a 200 OK message to the Controlled Device. 6. The User Control Point sends another NOTIFY (SID) message to the Controlled Device. 7. The Controlled Device sends another SubmitUpnpProperty-Event() message back to the User Control Point. 8. The User Control Point sends another 200 OK message to the Controlled Device. 9. The User Control Point sends an UNSUBSCRIBE (SID) message to the Controlled Device. 10. The Controlled Device sends a 200 OK message back to the User Control Point. 11. The User Control Point sends a DeRegisterNotification() message to the Controlled Device.

FIG. 25

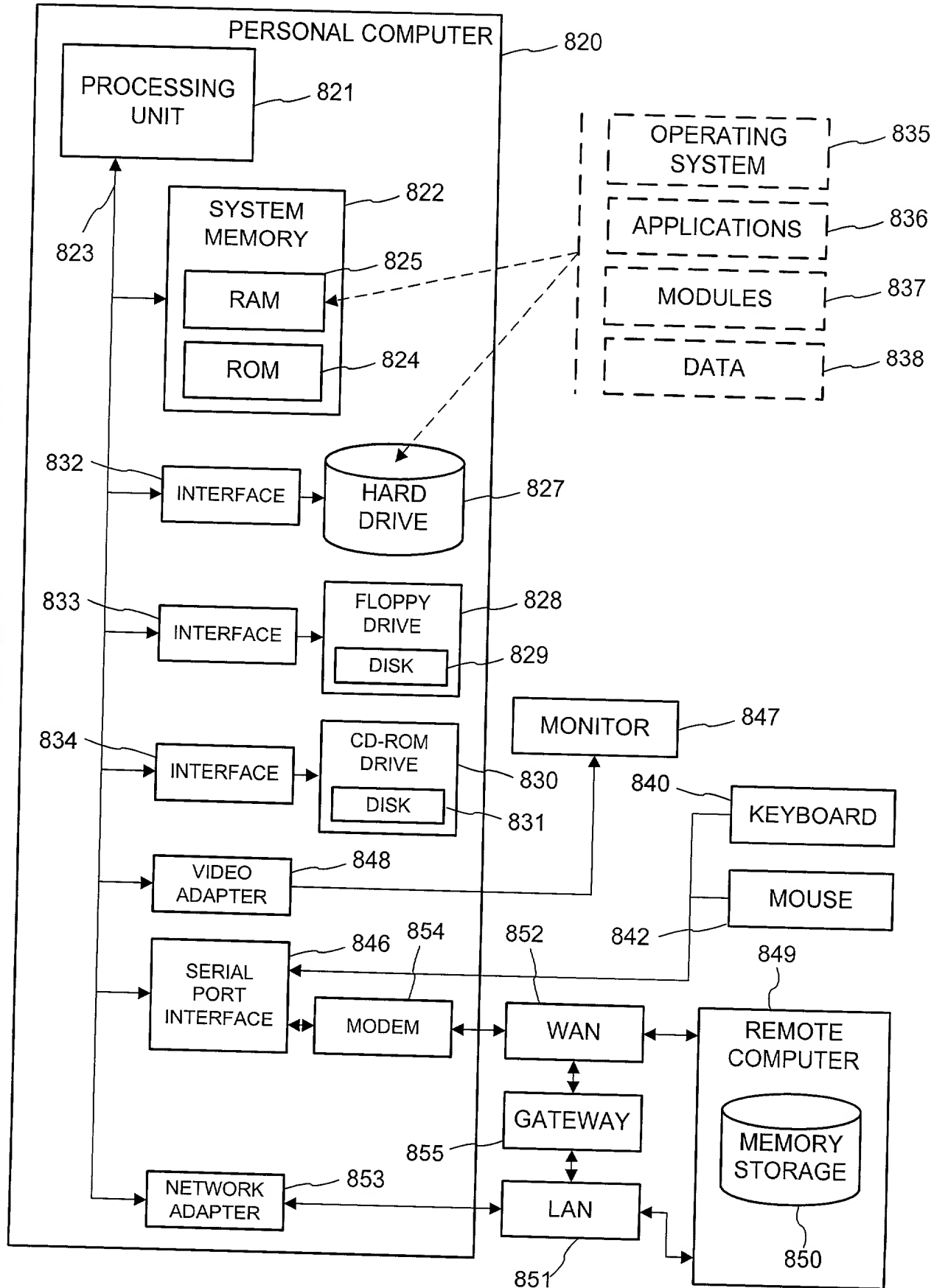


FIG. 26

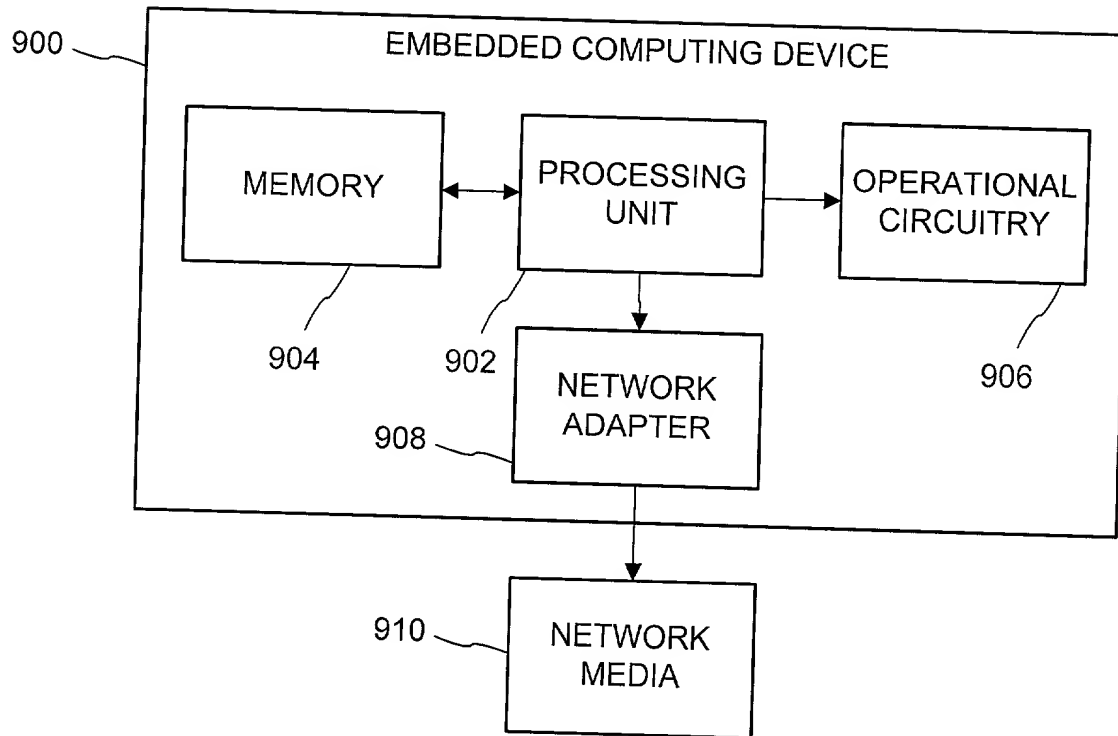


FIG. 27

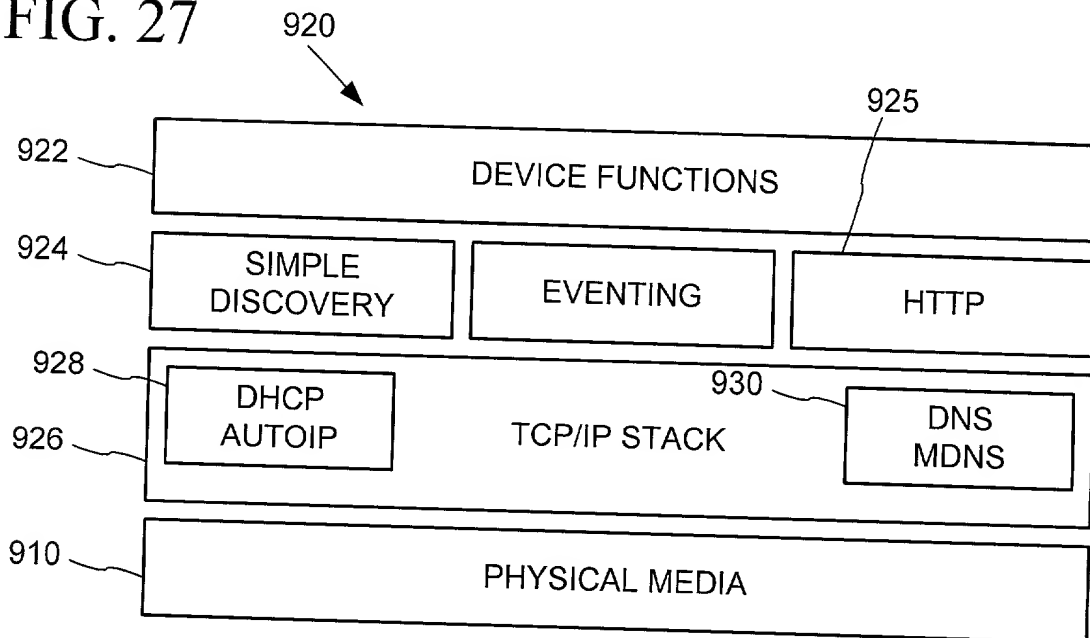


FIG. 28

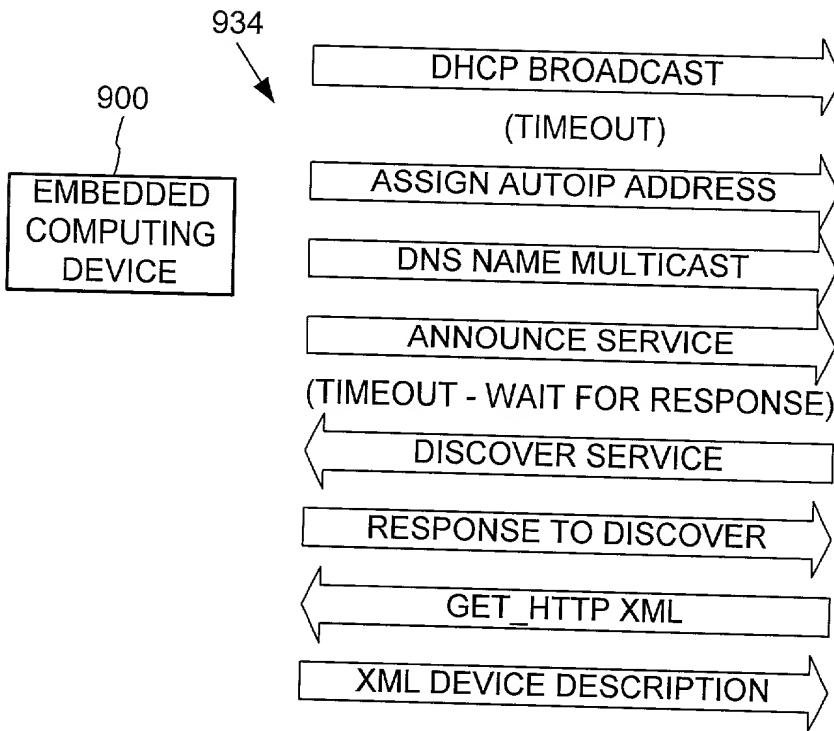


FIG. 29

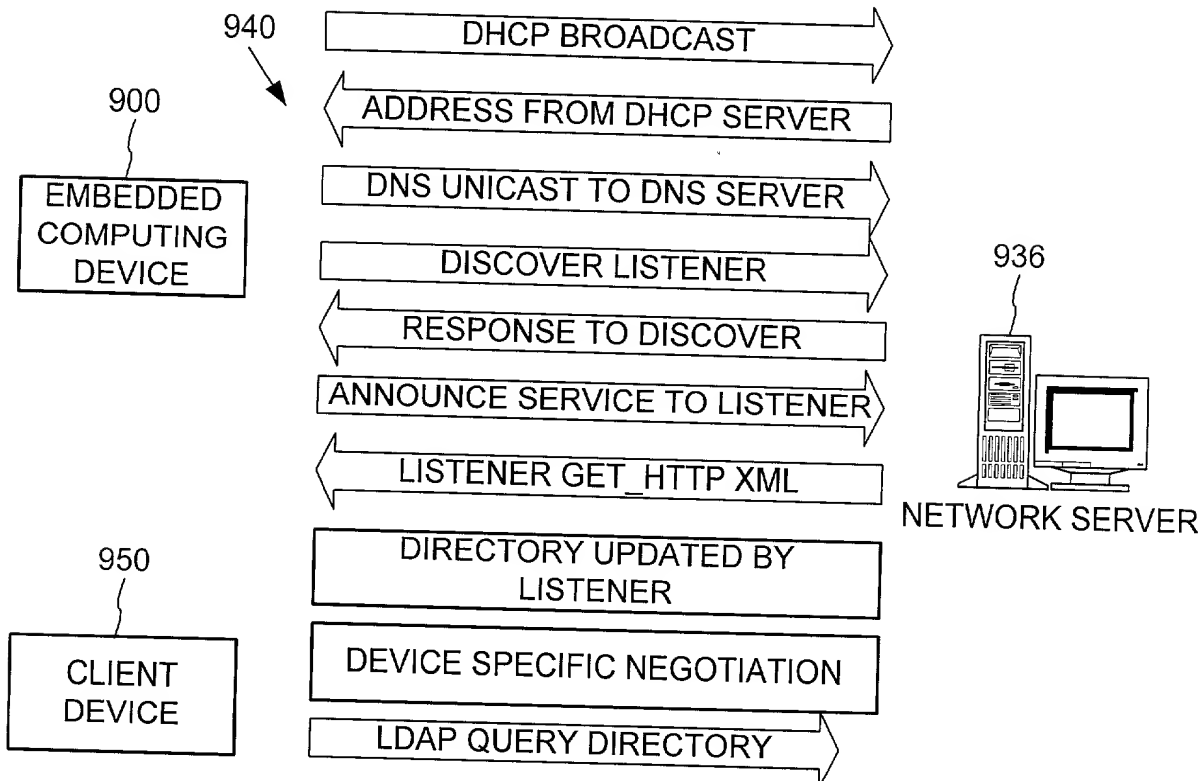


FIG. 30

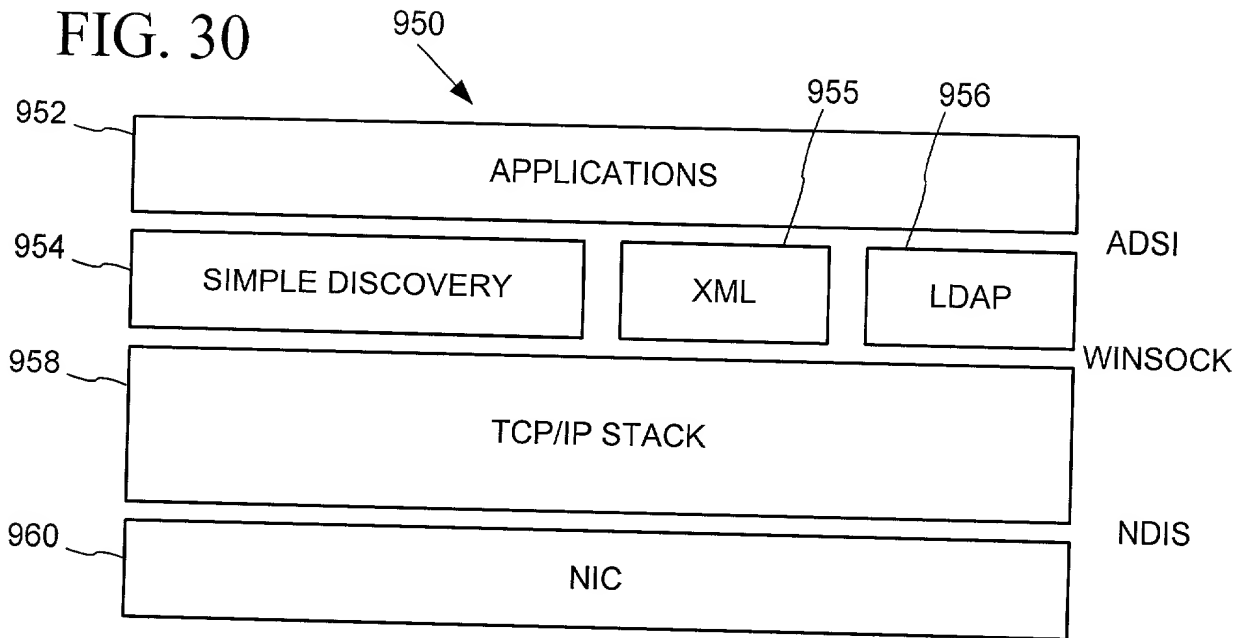


FIG. 31

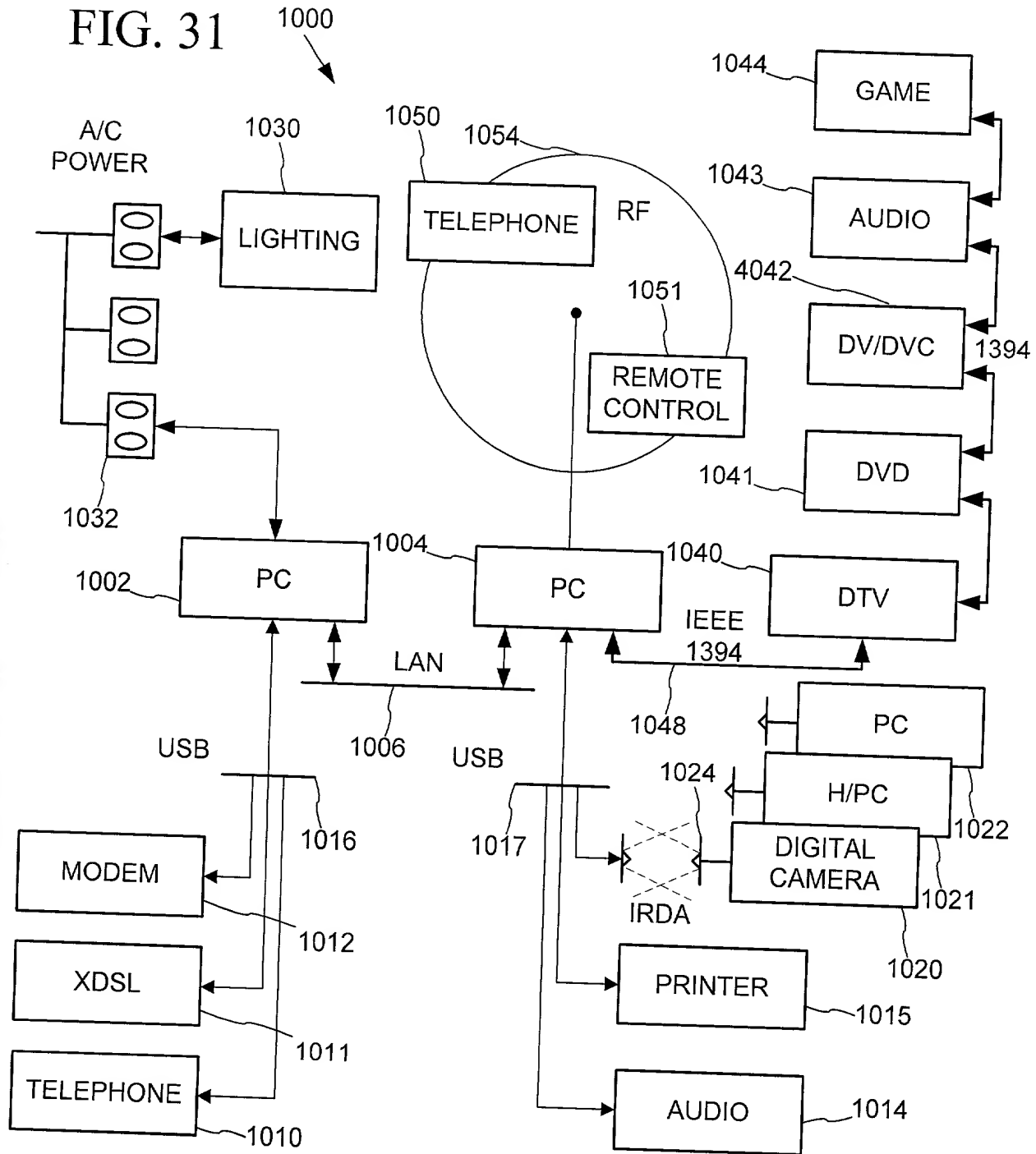


FIG. 32

```
[
  object,
  uuid(<foo>),
  dual,
  helpstring("IUPNPDevice interface"),
  pointer_default(unique)
]
interface IUPNPDevice : IDispatch
{

  [propget, id(DISPID_UPNPDEVICE_DESCRIPTIONDOCUMENT),
   helpstring("returns the document from which the properties of this device are
   being read")]
  HRESULT DescriptionDocument([restricted, hidden, out, retval]
  IUPNPDescriptionDocument ** ppuddDocument);
    purpose: returns the document from which the properties of this device are
    being read.
    parameters: ppuddDocument, A reference to the description document
    object from which data about the device is being read. This must be freed when no
    longer needed.
    return values: S_OK, ppuddDocument is a reference to the device's
    description document.

  [propget, id(DISPID_UPNPDEVICE_ISROOTDEVICE),
   helpstring("denotes whether the physical location information of this device can
   be set")]
  HRESULT IsRootDevice([out, retval] VARIANT_BOOL * pvarb);
    parameters: pvarb, the address of a VARIANT_BOOL that will receive the
    value of VARIANT_TRUE if the current device is the topmost device in the device
    tree, and will receive the value of VARIANT_FALSE otherwise.
    return values: S_OK, varb is set to the appropriate value
    note: if a device is a root device, calls RootDevice() or ParentDevice() will
    return NULL

  [propget, id(DISPID_UPNPDEVICE_ROOT),
   helpstring("returns the top device in the device tree")]
  HRESULT RootDevice([out, retval] IUPNPDevice ** ppudDeviceRoot);
    purpose: returns the top device in the device tree
  ...
}
```

FIG. 33

...

parameters: ppudDeviceRoot, On return, this refers to the "root" device of the current device tree. The root device is the topmost parent of the current device. If the current device is the root device this method will set *ppudDeviceRoot to null, and return S_FALSE.

return values: S_OK, *ppudDeviceRoot contains a reference to the root device. S_FALSE, the current device is the root device. *ppudDeviceRoot is null.

[propget, id(DISPID_UPNPDEVICE_PARENT),
helpstring("returns the parent of the current device")]

HRESULT ParentDevice([out, retval] IUPNPDevice ** ppudDeviceParent);

parameters: ppudDeviceParent, On return, if the device has a parent, this is the address of a IUPNPDevice object which can describe the parent. This must be released when no longer needed. If the device has no parent (it is a "root" device), than this value will be set to null.

return values: S_OK, ppudDeviceParent contains a reference to the device's parent. S_FALSE, the current device is the root device, which has no parent. *ppudDeviceRoot is null.

[propget, id(DISPID_UPNPDEVICE_CHILDREN),
helpstring("returns a collection of the children of the current device")]

HRESULT Children([out, retval] IUPNPDevices ** ppudChildren);

parameters: ppudChildren, On return, this is the address of a newly-created IUPNPDevices collection that can enumerate this device's children. This must be released when no longer needed. If the device has no children, this method will return a collection object with a length of zero.

return values: S_OK, ppudChildren contains a list of the device's children.

[propget, id(DISPID_UPNPDEVICE_UDN),
helpstring("returns the UDN of the device")]

HRESULT UniqueDeviceName([out, retval] BSTR * pbstrUDN);

parameters: pbstrUDN, On return, this contains the address of a newly-allocated string which contains the device's Unique Device Name (UDN). The UDN is globally unique across all devices - no two devices will ever have the same UDN. This value must be freed when no longer needed.

return values: S_OK pbstrUDN contains the UDN of the device

...

FIG. 34

...

[propget, id(DISPID_UPNPDEVICE_DISPLAYNAME),
helpstring("returns the (optional) display name of the device")]
HRESULT DisplayName([out, retval] BSTR * pbstrDisplayName);
parameters: pbstrDisplayName, On return, this contains the address of the device's display name. This value must be freed when no longer needed. If the device does not specify a display name, this parameter will be set to null.
return values: S_OK, bstrDisplayName contains the display name of the device. pbstrDisplayName must be freed. S_FALSE, the device did not specify a display name. *pbstrDisplayName is set to null.
note: it is possible for multiple devices to have the same display name.
Applications should use UniqueDeviceName() to determine if two device objects refer to the same device.

[propget, id(DISPID_UPNPDEVICE_CANSETDISPLAYNAME),
helpstring("denotes whether the physical location information of this device can be set")]
HRESULT CanSetDisplayName([out, retval] VARIANT_BOOL * pvarb);
parameters: pvarb, the address of a VARIANT_BOOL. This is true (!=0) on return when the device's display name can be set (via SetDisplayName)
return values: S_OK varb is set to the appropriate value

[id(DISPID_UPNPDEVICE_SETDISPLAYNAME),
helpstring("sets the display name on the device")]
HRESULT SetDisplayName([in] BSTR bstrDisplayName);
parameters: bstrDisplayName, the value to set the device's display name to.
return values: S_OK, varb is set to the appropriate value.
note: On success, this method sets the display name used by a device.
Note that this method changes the display name on the device itself, not simply on the local object. This will block while the name is being set.
Additionally, this change will be made on the device alone, and will not be reflected in the current device object. After a successful call to this method, DisplayName will continue to return the 'old' value). To read the device's current name, the caller must re-load the device's description.

[propget, id(DISPID_UPNPDEVICE_DEVICETYPE),
...

FIG. 35

...

helpstring("returns the device type URI")]
HRESULT Type([out, retval] BSTR * pbstrType);
parameters: pbstrType, On return, this contains the address of a newly-allocated string containing the device's type URI. This value must be freed when no longer needed.
return values: S_OK, bstrType contains the type URI of the device, and must be freed when no longer needed.

[propget, id(DISPID_UPNPDEVICE_SERVICES),
helpstring("returns the collection of services exposed by the device")]
HRESULT Services([out, retval] IUPNPServices ** ppusServices);
parameters: ppusServices, On return, this is the address of a newly-created IUPNPServices collection that can enumerate the services exposed by the device. This must be released when no longer needed. If the device exposes no services, this method will return a collection object with a length of zero.
return values: S_OK, pusServices contains a list of the device's children.

[propget, id(DISPID_UPNPDEVICE_SERVICEIDENTIFIER),
helpstring("returns the (optional) service identifier of the device")]
HRESULT ServiceIdentifier([out, retval] BSTR * pbstrServiceID);
parameters: pbstrServiceID, On return, this contains the address of a newly-allocated string containing the contents of the device's ServiceIdentifier element, if the device specifies one. This value must be freed when no longer needed. If the device does not specify a ServiceIdentifier value, this parameter will be set to null.
return value: S_OK, bstrServiceID contains the service identifier of the device. pbstrServiceID must be freed. S_FALSE, the device did not specify a service identifier. *pbstrServiceID is set to null.
note having a ServiceIdentifier is mutually exclusive with having services. Any device will either have a list of services or a ServiceIdentifier, but not both.

[id(DISPID_UPNPDEVICEDESCRIPTION_LOADSMALLICON),
helpstring("loads a small (titlebar-sized) icon representing the device, encoded in the specified format")]
HRESULT LoadSmallIcon([in] BSTR bstrEncodingFormat,
[out, retval] BSTR * pbstrIconURL);
parameters:

...

FIG. 36

...

bstrEncodingFormat, A string containing the mime-type representing the desired encoding format of the icon. pbstrIconURL, On return, *pbstrIconURL contains a newly-allocated string representing the URL from which the icon can be loaded. This string must be freed when no longer needed.

return values: S_OK, *pbstrIconURL contains a reference to an icon, encoded in the desired encoding format.

[id(DISPID_UPNPDEVICEDESCRIPTION_LOADICON),
helpstring("loads a standard-sized icon representing the device, encoded in the specified format")]

HRESULT LoadIcon([in] BSTR bstrEncodingFormat,
[out, retval] BSTR * pbstrIconURL);

parameters: bstrEncodingFormat, A string containing the mime-type representing the desired encoding format of the icon. pbstrIconURL, On return, *pbstrIconURL contains a newly-allocated string representing the URL from which the icon can be loaded. This string must be freed when no longer needed.

return values: S_OK, *pbstrIconURL contains a reference to an icon, encoded in the desired encoding format.

[propget, id(DISPID_UPNPDEVICEDESCRIPTION_PRESENTATIONURL),
helpstring("obtains a presentation URL to a web page that can control the device")]

HRESULT PresentationURL([out, retval] BSTR * pbstrURL);

parameters: pbstrURL, on return, the address of a newly-allocated string containing the web-page-based control URL. If the device did not specify a presentation URL, an empty string ("") will be returned.

return values: S_OK, bstrURL contains a newly-allocated URL that must be freed when no longer needed. S_FALSE, the device does not have a presentation URL. pbstrURL is set to null.

[propget, id(DISPID_UPNPDEVICEDESCRIPTION_PHYSICALLOCATION),
helpstring("a set of properties describing the device's physical location")]

HRESULT PhysicalLocation([out, retval] IUPNPPropertyBag * pupl);

parameters: pupl on return, the address of a newly-allocated UPNPPropertyBag object which contains information about the device's physical location

return values

...

FIG. 37

...

S_OK upl contains a newly-allocated object that the caller must free when it is no longer needed.

note: if the object does not provide any description information, an empty property bag will be returned. See SetPhysicalLocation for a listing of defined values in a physical location property bag.

[propget,
id(DISPID_UPNPDEVICEDESCRIPTION_CANSETPHYSICALLOCATION),
helpstring("denotes whether the physical location information of this device can be set")]
HRESULT CanSetPhysicalLocation([out, retval] VARIANT_BOOL * pvarb);
parameters: pvarb the address of a VARIANT_BOOL. This is true (!=0) on return when the device's physical location can be set (via SetPhysicalLocation)
return values: S_OK varb is set to the appropriate value

[id(DISPID_UPNPDEVICEDESCRIPTION_SETPHYSICALLOCATION),
helpstring("writes a set of properties describing the device's physical location to the device")]
HRESULT SetPhysicalLocation([in] IUPNPPropertyBag * pupl);
parameters: pupl A UPNPPropertyBag object which contains the name-value pairs representing the device's current location. the function will not free the object.
return values: S_OK the device has been updated with the supplied physical location information

note: the following are standard values in the physical location property bag: country, campus, building, floor, wing, room, latitude, longitude, altitude. These values can be used programmatically to implement sorting or filtering functionality based on the device's location. Additionally the property bag supports the following value: description, which contains a user-displayable string representing a device's location which does not have programmatic significance. Additionally, the physical location update will be made on the device alone, and will not be reflected in the current device object. After a successful call to this method, PhysicalLocation will continue to return the 'old' value. To read the device's current name, the caller must re-load the device's description.

}

...

FIG. 38

...
[propget, id(DISPID_UPNPDEVICEDESCRIPTION_PRODUCTNAME),
 helpstring("a displayable string containing the product name")]
HRESULT ProductName([out, retval] BSTR * pbstr);
 parameters: pbstr on return, the address of a newly-allocated string
 containing the product name of the device.
 return values: S_OK pbstr contains a newly-allocated string that must
 be freed when no longer needed.

[propget, id(DISPID_UPNPDEVICEDESCRIPTION_DESCRIPTION),
 helpstring("displayable summary of the device's function")]
HRESULT Description([out, retval] BSTR * pbstr);
 parameters: pbstr on return, the address of a newly-allocated string
 containing a short description of the device meaningful to the user.
 return values: S_OK pbstr contains a newly-allocated string that must
 be freed when no longer needed.

[propget, id(DISPID_UPNPDEVICEDESCRIPTION_MODELNAME),
 helpstring("displayable model name")]
HRESULT ModelName([out, retval] BSTR * pbstr);
 parameters: pbstr on return, the address of a newly-allocated string
 containing the manufacturer's model name of the device.
 return values: S_OK pbstr contains a newly-allocated string that must
 be freed when no longer needed.

[propget, id(DISPID_UPNPDEVICEDESCRIPTION_SERIALNUMBER),
 helpstring("displayable serial number")]
HRESULT SerialNumber([out, retval] BSTR * pbstr);
 parameters: pbstr on return, the address of a newly-allocated string
 containing the manufacturer's serial number of the device.
 return values: S_OK pbstr contains a newly-allocated string that must
 be freed when no longer needed.

 note: a device's serial number is not guaranteed to be globally unique. The
 DeviceUniqueName should always be used to distinguish devices.

[propget, id(DISPID_UPNPDEVICEDESCRIPTION_MANUFACTURERNAME),
 helpstring("displayable manufacturer name")]
HRESULT ManufacturerName([out, retval] BSTR * pbstr);
 parameters

...

FIG. 39

...

pbstr, on return, the address of a newly-allocated string containing the name of the device's manufacturer.

return values: S_OK, pbstr contains a newly-allocated string that must be freed when no longer needed.

```
[propget, id(DISPID_UPNPDEVICEDESCRIPTION_MANUFACTURERURL),  
  helpstring("URL to the manufacturer's website")]
```

```
HRESULT ManufacturerURL([out, retval] BSTR * pbstr);
```

parameters: pbstr, on return, the address of a newly-allocated string containing the URL of the manufacturer's website.

return values: S_OK, pbstr contains a newly-allocated string that must be freed when no longer needed.

```
[propget, id(DISPID_UPNPDEVICEDESCRIPTION_MODELNAME),  
  helpstring("displayable model name")]
```

```
HRESULT ModelName([out, retval] BSTR * pbstr);
```

parameters: pbstr, on return, the address of a newly-allocated string containing the manufacturer's model name for the device.

return values: S_OK, pbstr contains a newly-allocated string that must be freed when no longer needed.

```
[propget, id(DISPID_UPNPDEVICEDESCRIPTION_SUPPORTLIST),  
  helpstring("technical support contact information")]
```

```
HRESULT SupportList([out, retval] BSTR * pbstr);
```

parameters: pbstr, on return, the address of a newly-allocated, multi-line string containing phone numbers and other information that can guide the user to technical support. This string must be freed when no longer needed.

return values: S_OK, pbstr contains a newly-allocated string that must be freed when no longer needed.

```
[propget, id(DISPID_UPNPDEVICEDESCRIPTION_FAQLIST),  
  helpstring("FAQ access display information")]
```

```
HRESULT FAQList([out, retval] BSTR * pbstr);
```

parameters: pbstr, on return, the address of a newly-allocated, multi-line string containing FAQ information that can provide the user with URLs at which device FAQs may be located.

return values: S_OK, pbstr contains a newly-allocated string that must be freed when no longer needed.

...

FIG. 40

```
...
[propget, id(DISPID_UPNPDEVICEDESCRIPTION_UPDATELIST),
    helpstring("information explaining where the user can update the device's
firmware")]
HRESULT UpdateList([out, retval] BSTR * pbstr);
    parameters: pbstr, on return, the address of a newly-allocated, multi-line
string containing information and URLs from which the user can download updates
for the device's firmware.
    return values: S_OK, pbstr contains a newly-allocated string that must be
freed when no longer needed.
```

FIG. 40

FIG. 41

```
[
  object,
  uuid(FDBC0C73-BDA3-4C66-AC4F-F2D96FDAD68C),
  dual,
  helpstring("IUPNPDevices Interface"),
  pointer_default(unique)
]
IUPNPPROPERTYBAG
{

    [propget, id(DISPID_UPNP_PROPERTYBAG_READ),
     helpstring("reads a value from the property bag")]
    HRESULT Read([in] BSTR bstrName, [out, retval] VARIANT * pvarResult);
        parameters: bstrName, name of the property to read. case is ignored.
        pvarResultvalue of the property. if the property does not exist, this is of type
        VT_EMPTY
        return values: S_OK, the value was found in the property bag, and returned
        in pvarResult. S_FALSE, there was no value with the given name in the property
        bag. *pvarResult is of type VT_EMPTY

    [propget, id(DISPID_UPNP_PROPERTYBAG_WRITE),
     helpstring("writes a value to the property bag")]
    HRESULT Write([in] BSTR bstrName, [in] VARIANT * pvarValue);
        parameters: bstrName, name of the property to write. case is preserved
        when writing. The supplied value will replace any other values of the same name,
        even if they differ in case. pvarValue, value of the property to write.
        return values: S_OK, the value was written to the property bag, replacing the
        value currently associated with this property, if it existed.

    [propget, id(DISPID_UPNP_PROPERTYBAG_DELETE),
     helpstring("removes a value from the property bag")]
    HRESULT Delete([in] BSTR bstrName);
        parameters: bstrName, name of the value to remove from the property bag.
        case is ignored when finding a value to remove.
        return values: S_OK, the value has been removed from the property bag.
        S_FALSE, the value was not found in the property bag.

};
```

FIG. 42

```
[
  object,
  uuid(A295019C-DC65-47DD-90DC-7FE918A1AB44),
  dual,
  helpstring("IUPNPSERVICE Interface"),
  pointer_default(unique)
]
interface IUPNPSERVICE : IDispatch
{
  [id(1), helpstring("method GetProperty")]
  HRESULT GetProperty(
    [in] BSTR bstrPropertyName,
    [out, retval] VARIANT *pValue
  );

  [id(2), helpstring("method InvokeAction")]
  HRESULT InvokeAction(
    [in] BSTR bstrActionName,
    [in] VARIANT saActionArgs,
    [out, retval] long *plStatus
  );

  [propget, id(3), helpstring("property DCPI")]
  HRESULT DCPI(
    [out, retval] BSTR *pVal
  );

  [propget, id(4),
    helpstring("returns a manufacturer-defined extension property")]
  HRESULT VendorExtension([out, retval] VARIANT * pvarValue );
    parameters: pvarValueOn return, this variant is filled with the value of the
    "extension" element. If none exists, pvarValue is set to VT_EMPTY
    return values: S_OK, varValue is set to the extension element. S_FALSE,
    no vendor extension element exists. pvarValue is VT_EMPTY
```

FIG. 43

```
[
  object,
  uuid(FDBC0C73-BDA3-4C66-AC4F-F2D96FDAD68C),
  dual,
  helpstring("IUPNPDevices Interface"),
  pointer_default(unique)
]

interface IUPNPDevices : IDispatch
{
  [propget, id(1), helpstring("property Count")]
  HRESULT Count(
    [out, retval] long *pVal
  );

  [propget, id(DISPID_NEWENUM), helpstring("property _NewEnum")]
  HRESULT _NewEnum(
    [out, retval] LPUNKNOWN *pVal
  );

  [propget, id(DISPID_VALUE), helpstring("property Item")]
  HRESULT Item(
    [in] long lIndex,
    [out, retval] VARIANT *pVal
  );
};
```


FIG. 44

```
[
  object,
  uuid(3F8C8E9E-9A7A-4DC8-BC41-FF31FA374956),
  dual,
  helpstring("IUPNPServices Interface"),
  pointer_default(unique)
]
interface IUPNPServices : IDispatch
{
  [propget, id(1), helpstring("property Count")]
  HRESULT Count(
    [out, retval] long *pVal
  );

  [propget, id(DISPID_NEWENUM), helpstring("property _NewEnum")]
  HRESULT _NewEnum(
    [out, retval] LPUNKNOWN *pVal
  );

  [propget, id(DISPID_VALUE), helpstring("property Item")]
  HRESULT Item(
    [in] long lIndex,
    [out, retval] VARIANT *pVal
  );
};
```

FIG. 45

```

<contract>

  <protocol id="protocolDef">
    <HTTP version="1.1">
      <URL> http://investor.msn.com/stockquote </URL>
      <M-POST>
        <MAN> http://www.upnp.org/service-control/m-post </MAN>
      <M-POST>
        <HEADER name="Content-Type" value="text/xml" />
      </HTTP>
    </protocol>

    <RequestResponse name="getQuote">
      <protocol is="protocolDef" />
      <in    is="symbol" />
      <out   is="stockQuote" />
      <error is="error" />
    </RequestResponse>

    <RequestResponse name="getQuotes">
      <protocol is="protocolDef" />
      <in    is="symbols" />
      <out   is="stockQuotes" />
      <error is="error" />
    </RequestResponse>

    <!-- // schema definition follows -->

    <schema xmlns="urn:schema-microsoft-com:xml-data"
      xmlns:dt="urn:schema-microsoft-com:datatypes">

      <ElementType name="symbol" dt:type="string" />

      <ElementType name="symbols">
        <element type="symbol" maxOccurs="*" />
      </ElementType>

      <ElementType name="stockQuote">
        <element type="company" />
        <element type="ticker" />

```

...

FIG. 46

```
...
  <element type="previousClose" />
  <element type="openingTrade" />
  <element type="lastTrade" />
  <element type="volume" />
</ElementType>

<ElementType dt:type="string" name="company" />
<ElementType dt:type="string" name="ticker" />
<ElementType dt:type="string" name="previousClose" />
<ElementType dt:type="string" name="openingTrade" />
<ElementType dt:type="string" name="lastTrade" />
<ElementType dt:type="string" name="volume" />

<ElementType name="stockQuotes">
  <element name="stockQuote" maxOccurs="*" />
</Element>

<ElementType name="error">
  <element type="reason" />
</ElementType>

<ElementType dt:type="string" name="reason" />

</schema>

</contract>
Request for "getQuote"

M-POST /stockquotes HTTP/1.1
Host: amarg5:8586
Content-Type: text/xml
Man: "http://www.upnp.org/service-control/m-post"; ns=01
01-MethodName: getQuotes
01-MessageType: Call
Accept-Language: en-gb, en;q=0.8
Referer: http://amarg5/uPnPService/Services/Stock/Client/ticker.htm
Content-Length: 327
User-Agent: Mozilla/4.0 (compatible; MSIE 5.01; Windows NT 5.0)
Connection: Keep-Alive
```

...

FIG. 47

...

<symbol>MSFT</symbol>

Response for "getQuote"

HTTP/1.1 200 OK

Connection: close

Cache-Control: private

Date: Mon Aug 16 15:37:35 PDT 1999

Expires: Mon Aug 16 15:37:35 PDT 1999

Content-Type: text/xml

Content-Length: 7912

Man: "http://www.upnp.org/service-control/m-post"; ns=01

Ext:

01-MessageType: CallResponse

<stockQuote>

<company>Microsoft%20Corporation</company>

<ticker>MSFT</ticker>

<previousClose>84%2011/16</previousClose>

<openingTrade>85%201/16</openingTrade>

<lastTrade>84%205/16</lastTrade>

<volume>28.66%20Mil</volume>

</stockQuote>

FIG. 48

```
<!-- XDR Schema for protocol section of contract -->

<schema name="contract"
  xmlns="urn:schema-microsoft-com:xml-data"
  xmlns:dt="urn:schema-microsoft-com:datatypes">

  <ElementType name="contract"
    xmlns:protocolNS="contract-protocol"
    xmlns:msgPatternNS="contract-msgPatterns"
    xmlns:schemaNS="urn:schema-microsoft-com:xml-data">

    <element type="protocolNS:protocol" />

    <element type="msgPatternNS:RequestResponse" minOccurs="0"
maxOccurs="*" />
    <element type="msgPatternNS:SolicitResponse" minOccurs="0" maxOccurs="*"
/>

    <element type="schemaNS:schema"          minOccurs="0" maxOccurs="*" />

  </ElementType>

</schema>
...
```

FIG. 49

...

Protocol

<!-- XDR Schema for protocol section of contract -->

```
<schema name="contract-protocol"
  xmlns="urn:schema-microsoft-com:xml-data"
  xmlns:dt="urn:schema-microsoft-com:datatypes">
```

```
<ElementType name="protocol">
```

```
<!-- ID -->
```

```
<AttributeType name="id" dt:type="id" />
```

```
<Attribute type="id" />
```

```
<group order="one">
```

```
<element xmlns:http="contract-protocol-HTTP" type="http:HTTP" />
```

```
<element xmlns:gena="contract-protocol-GENA" type="gena:GENA" />
```

```
// other protocol definitions go here
```

```
</group>
```

```
</ElementType>
```

```
</schema>
```

...

FIG. 50

...

HTTP

<!-- XDR Schema for HTTP section of contract -->

```
<schema name="contract-protocol-HTTP"
  xmlns="urn:schema-microsoft-com:xml-data"
  xmlns:dt="urn:schema-microsoft-com:datatypes">
```

```
<ElementType name="HTTP">
```

```
<!-- HTTP version -->
```

```
<AttributeType name="VERSION" dt:type="string" default="1.1" />
```

```
<Attribute type="VERSION" />
```

```
<!-- The Verb to use -->
```

```
<group order="one">
```

```
<element type="GET" />
```

```
<element type="POST" />
```

```
<element type="M-POST" />
```

```
</group>
```

```
<!-- The protocol data -->
```

```
<element type="URL" />
```

```
<element type="QUERY" minOccurs="0" />
```

```
<element type="HEADER" minOccurs="0" />
```

```
</ElementType>
```

```
<ElementType name="URL" dt:type="string" />
```

```
<ElementType name="QUERY">
```

```
<attribute type="name" />
```

```
<attribute type="value" />
```

```
<attribute type="required" />
```

```
</ElementType>
```

...

FIG.51

...

```
<ElementType name="HEADER">
  <attribute type="name" />
  <attribute type="value" required="yes" />
</ElementType>
```

```
<!-- Verb declarations -->
```

```
<ElementType name="GET"/>
```

```
<ElementType name="POST">
```

```
  <element type="PARAM" minOccurs="0" maxOccurs="*" />
</ElementType>
```

```
<ElementType name="PARAM">
```

```
  <element type="name" />
```

```
  <element type="default" />
```

```
  <element type="value" />
```

```
  <element type="required" />
```

```
</ElementType>
```

```
<AttributeType name="name" dt:type="string" required="yes" />
```

```
<AttributeType name="default" dt:type="string" />
```

```
<AttributeType name="value" dt:type="string" />
```

```
<AttributeType name="required" dt:type="boolean" default="no" />
```

```
<ElementType name="M-POST">
```

```
  <element type="MAN" />
```

```
</ElementType>
```

```
<ElementType name="MAN" dt:type="string" />
```

```
</schema>
```